

Rangeland Degradation and Rehabilitation: Indigenous Ecological Knowledge and Perceptions of Pastoralists in the Adamawa High Plateau of Cameroon

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Abstract— Pastoralists' perceptions and indigenous ecological knowledge of vegetation changes are often ignored despite the debate about their role in rangeland management. Yet, pastoralists are known to have extensive ecological knowledge which could complement scientific knowledge and contribute to improved understanding and sustainable management of savanna Ecosystems. This study was aimed at exploring pastoralists' perceptions regarding rangeland degradation in the Adamawa highland plateau. More specifically, it was geared to examine their awareness of rangeland degradation, the current status/condition of the rangelands, the drivers and major root causes of degradation, negative consequences, existing management practices, and a methodological framework to make these measures more resilient. The study applied a descriptive statistics method. Focus group discussions, field observations and structured/semi-structured survey questionnaires, were used for data collection, where 240 pastoralists were targeted. The study covered 4 sub-divisions within Faro & Deo District of the plateau based on the intensity of degradation (high, medium and less). The major findings indicate that, the main livelihood activity is cattle rearing and crop cultivation (86.43%) with a certain degree of sedentarization. The major livestock production constraint proved to be insufficient and poor pasture available for cattle (65.71%). A great majority (93.6%) also confirmed that the present rangeland state/condition has become poor and non-conducive for cattle production. This is clearly interpreted in the drastic drop of the 'cheptel' (average holdings) and a decline in the quality of pastoral resources/outputs offered to the communities. The major root causes of degradation were overgrazing, bush encroachment, uncontrolled bush fires, soil erosion, population pressure and limited care/attention paid to rangelands. The major socio-economic consequences were poverty, food insecurity, conflicts, loss of cultural heritage, rural exodus and high crime waves. Through their indigenous ecological knowledge pastoralists conserve their rangelands through: mechanical and chemical fight against bush encroachment (Bush clearing and use of selective herbicide respectively), seasonal herd mobility/transhumance, use of paddocking systems, destocking of herds, adoption of improved pastures, and improvement on pastoral hydraulics. Government and NGOs' supports to rangeland management, proved to be limited in the study area. The degradation of rangelands in the study area is progressing at an alarming rate which gives the impression of difficulty to restore it in the future if proper measures are not taken by stakeholders.

Keywords— Degradation, Ecology, Indigenous, Pastoralism, Perception, Rangeland.

I. INTRODUCTION

Rangeland ecosystems are among the earth's largest terrestrial ecosystems and are found in all continents of the world (Kreutzmann et al., 2011; Lund, 2007; Mannetje,

2002; Blench and Sommer, 1999; Fig. 1.1). The various definitions of rangelands that have been proposed can possibly be attributed to the huge variety of rangelands that cover diverse vegetation types (Sayre et al., 2013; Lund,

2007). This study adopts the general definition provided by Mannetje (2002), in which rangelands refer to ecosystems which carry a vegetation consisting of native and/or naturalized species of grasses and dicotyledonous herbs, trees and shrubs, used for grazing or browsing by wild and domestic animals, on which management is restricted to grazing, burning and control of woody plants.

Livestock production is found in approximately two thirds of rangelands worldwide, with about 1 billion people mainly depending on livestock for their livelihoods and about 70 percent of the rural poor households partially depending on livestock as a source of income (Ashley et al., 1999; Neely et al., 2009). It is believed that livestock grazing is associated with rangeland degradation (Bahareh et al., 2016).

Rangeland degradation is the most extensive among the major types of current land use pattern and few countries have less than 50% of their pastoral lands degraded (World Bank, 1992). Dregne et al., (1991) for example also estimated that 73% of the world's 4.5 Billion hectares of rangeland are moderately or severely degraded. Furthermore, Bruce (2007) also reviewed that 20% of the world's pastures are considered to be degraded through overgrazing, compaction and erosion, where overgrazing accounts for 35% of the land degradation worldwide.

Despite the value of rangelands terrestrial ecosystem services, their stewardship is undermined by various factors leading to considerable rangeland degradation around the world (Hatfield and Davies, 2006; Neely et al., 2009). Pastoral communities' participation in decision making for environmental monitoring is regarded as one of the pillars of sound rangeland management (Oba, 2012). There are three assumptions involved. Firstly, it is acknowledged that pastoralists have their own experiences and knowledge, which they have used for generations to manage the rangelands. Secondly, it is assumed that their knowledge is measurable and comparable across communities. Thirdly, it is assumed that their knowledge and its outcomes can make an important contribution to the development of local policies (Oba, 2012). Nevertheless, rangeland researchers have generally not incorporated into their research how this knowledge is generated and may be applied (*Ibid.*). Its usefulness in complementing existing

scientific knowledge for the assessment and monitoring of rangelands is therefore little understood. Indeed, there is limited information on the comparability of indigenous knowledge across pastoral communities in different regions of Africa (see also, Oba et al. 2008a, b; Roba and Oba 2008, 2009).

This study has as objective to analyze the perceptions of pastoralists on rangeland degradation and management in the Adamawa high plateau of Cameroon. It focuses specifically to i.) Examine the awareness and attitudes of pastoralists towards the degradation of Rangeland resources in terms of Grazing, Biodiversity and Fuel-wood/Veldt products. ii.) Describe the current range condition of the area iii.) Identify major root causes and drivers of rangeland degradation as perceived by pastoralists iv.) Assess and analyze the consequences of rangeland degradation on the local communities v.) Examine and analyze the indigenous management methods and adaptation strategies that are used to manage the rangelands, and what the pastoralists consider to be the most possible and workable of these adaptation strategies/solutions to the problem of rangeland degradation in the study area vi.) Examine and analyze the technical (modern) management methods and existing institutions that tackle the question of rangeland degradation, and their effectiveness.

II. METHODOLOGY

2.1 The study area

The Adamawa Highland Plateau is a constituent region of the Republic of Cameroon. It is situated in the centre of the country and covers 17% of the national territory. It lies between latitudes 6° and 8° north, and its elevation varies between 900 and 1,500 meters, with an average of 1,100 m. The plateau is essentially a gigantic horst-like massif originating in Nigeria, crossing Cameroon and penetrating far into the Central African Republic. This mountainous area forms the barrier between Cameroon's forested south the Savanna north. At almost 64,000 Km² in land area, the Adamawa is the third largest of Cameroon's ten regions. The land is rugged and sparsely populated, however, as most is devoted to the rearing of cattle.

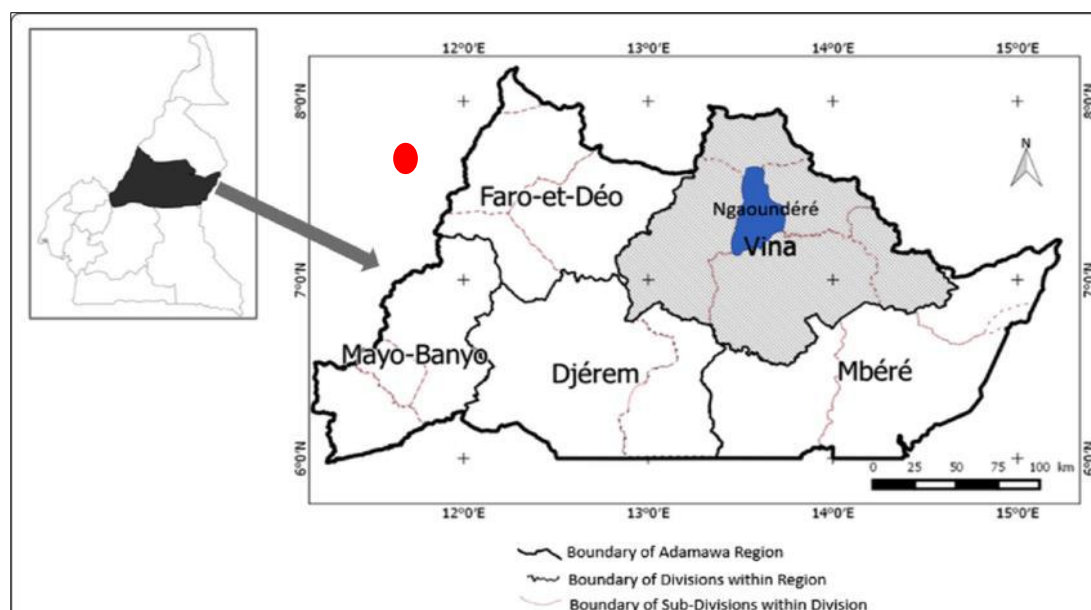


Fig.1: Map showing the location of Adamawa Region in Cameroon and the study area within the region.

The climate of the Adamawa plateau is classified as Tropical of the Sudan type. It has only two seasons; the dry season which runs from November to March and a long rainy season which runs from April to October. It is covered with savannah-type vegetation, more than 90% of which consists of *Daniellia olivert* and *Lophira lanceolata* (Letouzey, 1969). Other common tree and grass species are *Isoberlinia doka* and *Sporobolus africanus* respectively (De-Wispelaere, 1994). The 2015 general population and housing census, place the total population of the division at about 1,200,095 inhabitants.

2.2 Sampling procedure and data collection

Both Probability (random or representative) sampling and Non-probability (Non-random or judgement) sampling techniques were employed in this study.

Firstly, the type of non-probability sampling method used here was the Purposive sampling method which was used to select the division (part/area of the highland plateau to cover) and the sub-divisions (units of the division/district to be effectively involved) including the sample size of the pastoralists interviewed in each unit. The selection of the division and the sub-division was based on the study of rangeland made by Forgiarini and Klein (2004) in the Adamawa. These two researchers classified the Adamawa rangeland in six floristic groups: the less grazed grassy savannah (found on dry season pastures or on protected areas), the grazed grassy savannah, the grazed grassy savannah with copse shrubs, the shrub savannah, the wooded savannah and the forest. The four first floristic groups were selected to represent the effective pasture of the Adamawa. The other two (wooded savannah and

forest) were discarded because of (almost) absence of the grassy stratum in these groups. It is worth noting that the grassy stratum represents the major cattle feed source in the Adamawa (Dulieu and Rippstein, 1980). Faro & Deo district part (North West) of the Adamawa highland plateau has more of the grassy stratum (the less grazed grassy savannah and the grassy savanna). Nevertheless, it can also be concluded with certitude that, all the sub-divisions within this district has representative samples of all the six floristic groups following the classification of Forgiarini and Klein (2004). At the level of each floristic group selected, one representative community or territory (area with more than one village), preferably, the one having the highest cattle population, was chosen to represent the group. Therefore, Mayo-Baleo, Kontcha, Galim-Tigné, and Tigné communities, representing the less grazed grassy savannah (dry season pastures), the grazed grassy savannah, the grassy savannah with copse shrubs and the shrub savannah respectively, were chosen as representative sample pastures of the Adamawa highland plateau. It is worth noting that all these sites were purposely chosen in the Faro & Deo division since this division is quite representative of the Adamawa in terms of forage/pasture and cattle production.

Secondly, the type of probability sampling method used here was the simple random sampling. This method was employed to select the target population of the study. As a result, 240 pastoralists were randomly selected from the target population of 1,181 pastoralists giving a percentage validity of 20.32%.

2.3 Statistical analysis

Data collected were analysed with the help of two computer software programs; statistical package for social sciences (SPSS) version 14 and Microsoft office Excel 2010. The descriptive statistics was used for the analysis. The descriptive statistics made use of frequency

distribution, means and percentages. To facilitate the interpretation, results were illustrated through the use of tables, pie charts, bar charts and sometimes demonstrative photos from field observations.

III. RESULTS AND DISCUSSION

3.1 The socio-economic characteristics of pastoralist households:

Table 1: Distribution of Respondents by Socio-economic characteristics

Variable	Frequency	Percentage
Sex of Respondent		
• Male	275	98.2
• Female	5	1.8
Age of Respondent		
• 0 – 19	26	9.3
• 20 – 39	94	33.6
• 40 – 59	120	42.9
• 60 and Above	40	14.3
Household size		
• 1 – 5	34	12.1
• 6 – 10	60	21.4
• 11 – 15	89	31.8
• 16 - 20	67	23.9
• 21 and Above	30	10.7
Marital status		
• Married	252	90.0
• Single	19	6.8
• Divorced	2	0.7
• Widow/Widower	7	2.7
Level of Education		
• Non lettered	204	72.86
• Primary education	57	20.36
• Secondary education	14	5.00
• Higher education	5	1.79
Main livelihood activity		
• Cattle rearing only	16	5.71
• Cattle rearing and crop cultivation	242	86.43
• Cattle rearing and trading	22	7.86

From table 2, the highest represented age group in pastoral activities in the study area is 40 – 59 years (42.9%) followed by the age group 20 – 39 (33.6%).

Therefore, the middle class age group is the main actors of pastoral activities within the zone. Results also show that, a great majority of the respondents were from the men

folks (98.2% represented) with only 1.8% of women represented. It is clear that pastoral activities are mostly carried out by men given the nature of the activity. Again from the results, majority of the pastoralists were married (90.0%) against 6.0% single cases with large household sizes ranging from 11 – 20 persons as seen in table 1. This is true especially amongst the fulanis (who form a bulk of the respondents) where there is high polygamy and dependency rates thus corresponding with literature from Encyclopedia of world cultures (2018). Again, a large majority (72.86%) of pastoralists do not have any formal education. This class of pastoralists can neither read nor write. Furthermore, a large majority (86.43%) are agro-pastoralists who earn a living from both agriculture and pastoralism. They live more of a sedentary lifestyle. They are now highly involved in peasant activities as said by Nji, (1995).

3.2 Pastoralists' awareness and attitudes towards rangeland degradation in the study area.

A great majority of over 93.6% of respondents said their rangeland condition is poor and not conducive for cattle rearing. Pastoralists were asked if they observe negative changes in the condition of their rangelands from the previous years. All pastoralists (100.0%) responded in the affirmative saying there is a decline in the quality of pastoral resources found in their rangelands. Focus group members also affirmed that the poor condition of their rangelands signifies encroachment of unwanted species of pasture e.g. Bokassa grass, Memossa etc., overgrazing leading to bare soils, disappearance of pastoral resources beneficial to the communities e.g. fuel wood, medicinal plants etc. This shows that, the condition of rangeland in the study area have been deteriorating from the past years (degradation) and that, the people were conscious of these changes.

Furthermore, pastoralists did not only confirm their awareness of rangeland degradation but also had indigenous knowledge and could tell how these negative changes have evolved over the past 10 years. Members of

focus group discussion confirmed that, biodiversity depletion is now visible within their area interpreted through changes in vegetation cover, wildlife scarcity, scarcity of veld products, extinction of certain medicinal trees and plant species, scarcity of high quality thatching grass and scarcity of quality fuel wood. They have noticed that their rangelands are increasingly being deprived from these essential resources that they used to benefit from in the past. The participants also iterated that, in the past, they did not have to cover long distances to harvest some of these products. However, the situation is becoming reversible today. These results interprets very sufficiently that pastoralists in the study area are not only aware and conscious of their rangeland condition but are also capable of interpreting the changes they see on their rangelands and environment as a whole.

3.3 Current status of rangelands in the study area.

3.3.1 State of rangelands with bush encroachments in the study area.

According to the regional delegation for livestock, fisheries and animal industries, in the Adamawa region, almost $\frac{3}{4}$ of the surface area of the Adamawa region have been colonized either by trees, shrubs, or bushes. This is a similar statistic given by IRAD (department of forage production), Ngaoundéré. According to participants of focus group discussion, bush encroachment especially with bokassa and mimosa plants are the order of the day. The former is a greater threat for communities within the study area. Following discussions with the divisional delegate of MINEPIA for Faro and Deo, very few zones in this division have patches of good organized pastures otherwise known as 'SABBAL' in Fulfulde. These good upland pastures include; Sabbal Mbambo, sabbal Gandaba, sabbal Mbana and SODEPA Faro ranch. These are the few zones within the study area that still have good traces of pastures. The following images depict zones colonized by chromolaena odorata and mimosa spp in the study area.



A



B

Photo 1: Bush encroachment of Bokassa grass in Libong-Mboum and Tignère (both in Tignère sub-division) respectively.



A



B

Photo 2: Mimosa grass encroachment in Mayo-Dankali and Lompta (both in Galim-Tignère sub-division) respectively.



A



B

Photo 3: Shrubs and trees encroachment in Karedje (Tignère sub-division).

3.3.2 State of rangelands with bare soils and ravine/gullies in the study area.

Apart from bush encroachments which mostly prevent good quality pasture from growing, other zones are completely deprived from pasture due soil erosion leaving bare grounds, ravine or gullies. According to FG participants, these ravine and gullies sometimes leave

behind lots of losses for their animals in terms of fractures and mortalities. Again, according to the regional delegation for MINEPIA (Service for pasture amelioration and pastoral hydraulics), soil erosion has left bare soils and gullies in some zones making access very difficult for both cattle and humans. The following images again depict the situation from field observations.



A



B

Photo 4: Gully created as a result of soil erosion in Dodéo (Kontcha sub-division).

3.3.3 State of rangelands with poor state of 'regoldés' (drinking spots) in the study area.

The state of drinking spots (known as *Regoldés* in Fulfuldé) in the study area is deplorable. Animals do not have access to some of these drinking spots because of their poor states. Again according to FG members, local

drinking points (*Regoldés*) usually become inaccessible especially during the rainy season with too much rains. Some of these drinking spots are the cause of fractures and mortalities for animals during this period they said. The following images gotten from field observation explain the scenario.



A



B

Photo 5: Poor states of drinking spots (*regoldés*) in Doualayel (Tignére sub-division) and Gadjiwan (Mayo-Baléo sub-division) respectively.

3.3.4 State of rangelands with poisonous plants and noxious species in the study area.

One of the most recent causes of mortalities of cattle especially during the dry season is the consumption of poisonous/toxic and noxious plant species within the study area. This is confirmed by the regional chief of service for pasture and pastoral hydraulics (MINEPIA, Ngaoundéré) who said most upland areas become very dry

(including grass species) during the dry season and animals, being attracted by fresh materials and relatively cool environments tend to enter into galleries and enclave areas where they meet these poisonous plants and other noxious species which finally leads to their mortalities. The most common poisonous plant within the study area is *spondiantus spp.* Noxious species include; Mimosa and Bracken fern in some areas.



Photo 6: *Spondianthus* spp. (Poisonous plants) in Tignére and Libong (both in Tignére sub-division) respectively.

3.4. Drivers and Causes of rangeland degradation in the study area as perceived by pastoralists.

3.4.1. Drivers of rangeland degradation according to the pastoralists

The following table presents the opinions of pastoralists on the major drivers of rangeland degradation in the study area.

Table 2: Drivers of rangeland degradation according to pastoralists in the study area.

What in your opinion are the main drivers of rangeland degradation?

Parameters	Frequency	Percentage
Physical factors i.e. Temperature, Rainfall, Sunshine, etc.	20	7.1
Human factor	7	2.5
Both physical and human factors	253	90.4
Total	280	100.0

From table 5 above, the major drivers of rangeland degradation are physical and human factors. Physical factor here mainly signifies climate with parameters such as; temperature, rainfall, humidity, sunshine, etc. According to pastoralists, these parameters per se are not the bone of contention but the problematic lies in their irregularities. In recent years, there have been a lot of irregularities especially with pluviometry in the study area they said. As a result, it is now difficult to predict the beginning and end of both the rainy and dry season. Irregularities in climatic parameters do not only affect rangeland health but also have a significant effect on reproduction, animal health and zoo-technical operations.

Furthermore, human factor according to the pastoralists, is man who stands at the center of rangeland

management and development. The contribution of man is indispensable in rangeland management. According to pastoralists, the high levels of degradation is due to the mismanagement practices of man interpreted through overgrazing, high stocking rates, uncontrolled bush fires, urbanization, over-exploitation of rangeland resources etc. These accompanied with climatic factors are the main drivers of rangeland degradation.

3.4.2. Causes of rangeland degradation as perceived by pastoralists.

The following table gives a highlight of the various causes of rangeland degradation as perceived by pastoralists in the study area.

Table 3: Causes of rangeland degradation as perceived by pastoralists in the study area.

Parameters	Frequency	Percentage(%)
Overgrazing	92	32.9
Bush encroachments	101	36.0
Bush fires	20	7.1
Soil erosion	7	2.5
Population pressure	17	6.1
Limited care and attention paid to rangelands	43	15.4
Total	280	100.0

From table 6, the main causes of rangeland degradation in the study area are; overgrazing, bush encroachments, bush fires, soil erosion accounting for 32.9%, 51.4%, 7.1%, and 2.5% of responses respectively.

3.4.2.1. Overstocking and Overgrazing.

Overgrazing occurs when the number of livestock exceeds the carrying capacity of the pasture; when food demand exceeds food production. According to some of the respondents(32.9%) and focus group discussion participants, overgrazing is one of the main factors causing degradation of rangelands. This corresponds with the statistics of Barrow (1991) regarding the fact that overgrazing by livestock is the principal land problem. Small ruminants like sheep, goats, donkeys and other large ruminants like horses owned by pastoralists also contribute to this phenomenon as said by respondents.

According to discussions with focus group participants, overgrazing is mostly caused by overstocking (putting more animals in an area, than it is capable of supporting) thus corresponding with the literature of Herrera *et al.*, (2008). Moreover, another contributing factor to overgrazing they say is the inaccessibility of their grazing terrain caused by bushes, shrubs and trees encroachment. As a result, their animals cannot graze or get free and full access to all parts of the grazing zone. They are therefore bound to be stock within a small surface area, in which their continuous action on the little available pasture provokes overgrazing. Farmlands of neighboring farmers found in grazing zones, is also a contributing factor to this phenomenon the pastoralists iterated. They are forced to graze their cattle on a limited surface area for fear that their animals may roam far and enter into farmlands thus destroying crops. When overgrazing occurs, there is limited pasture available for the cattle and thus creating an

insufficiency in their nutritional needs hence in the same light with results of IFAD (2003) in the literature. This puts a negative impact both in the quantity and quality of livestock production particularly cattle production. Again, the situation of overgrazing is aggravated most especially during the dry season characterized by limited pasture, as the focus group members said.

3.4.2.2. Bush encroachment in the study area.

Bush encroachment accounts for over 51.4% of responses as the main cause of rangeland degradation. It is considered the most extensive forms of rangeland degradation in the study area, hence not different from what Schroter *et al.*, (2010) said concerning bush encroachment in arid and semi-arid regions of the Earth. Encroachments by unwanted plant species such as the Bokassa grass (*Chromolaena odorata*) is a big threat for the pastoral communities in the study area. Similar to this are the findings of Blasius (2009) regarding Bokassa encroachments in the country as a whole. *Chromolaena odorata* has been reported to be the most problematic invasive specie within protected rainforests in Africa (Wikipedia encyclopedia, 2018). It contains carcinogenic pyrrolizidine alkaloids which are toxic to cattle; it can also cause allergic reactions (ibid.). The Mimosa plant is another encroachment species within the rangelands of the study area. This plant is not poisonous per se but the hairy thorns have adverse effects in the body of an animal and can sometimes lead to death.

3.4.2.3. Bush Fires

Bush fire *per se* is not a cause of rangeland degradation but an uncontrolled or poor management. In fact fire is an efficient tool used in rangeland management. Pastoralists in the study area use fire in the management of their rangelands. The bush is set on fire at the very onset of the dry season (usually between November and December).

The following figure presents the responses of pastoralists on the utilization of fire on their rangelands.

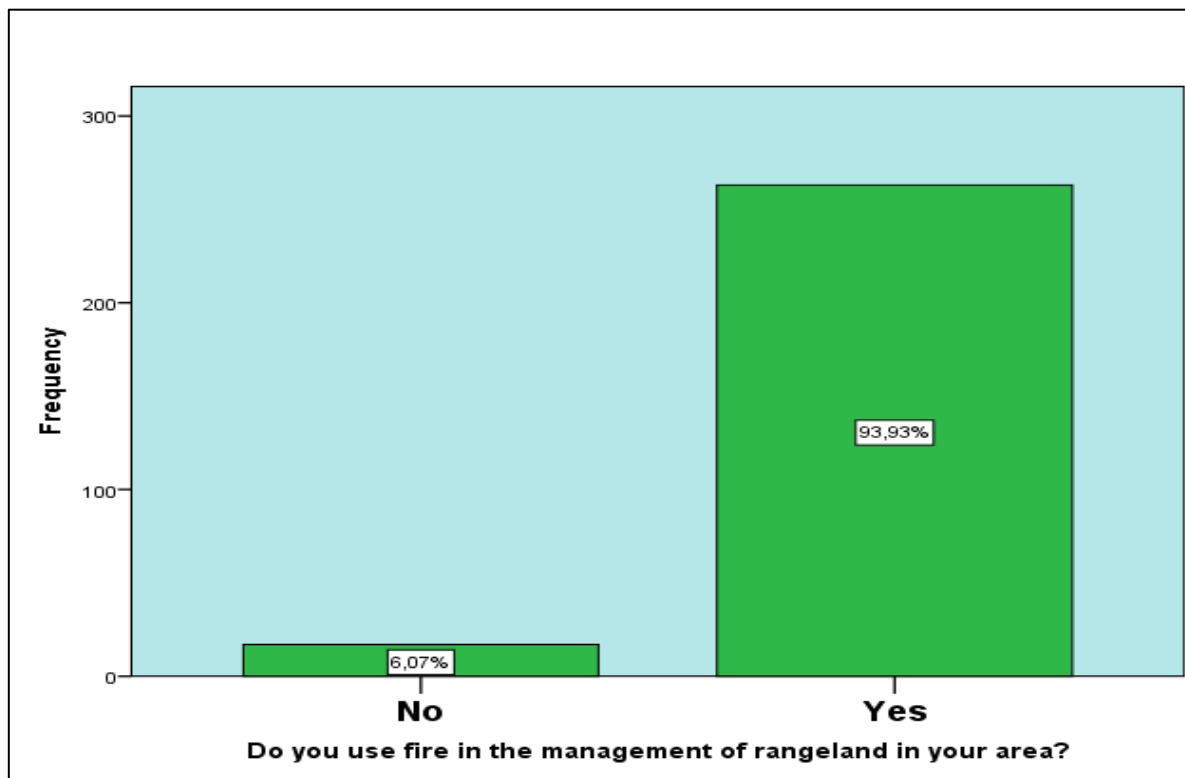


Fig.2: Use of bush fires in the management of rangelands in the study area.

From Figure 6, a great majority of over 93.93% of respondents uses fire in the management of their rangelands. Pastoralists were further asked if they believed bush fire is good for rangeland management. Again, a great majority of over 93.6% responded in the affirmative and that, the proper use of fire on rangelands is indispensable because it helps to eradicate/reduce the encroachment of bushes (shrubs, trees and noxious species e.g. Bokassa and Mimosa plants). It also favors the germination and growth of good pasture. Furthermore, it reduces disease infestation on rangelands and gets rid of harmful predators and pest dangerous to both animals and humans. Brief, controlled bush fire helps regenerate and give back life to degraded rangelands they said.

Pastoralists however lamented on the devastating consequences of bush fires in their communities during recent years. They have lost huge and expensive properties including houses/habitations and business premises, crops on farmlands, beehives for honey production, and sometimes lives of family members. All these are as a result of either stubbornness of herdsmen in following instructions of their leaders or bad intentions from some hypocrites within the community they said.

3.4.2.4 Soil erosion in the study area.

Soil erosion even though not very pronounced in the study area, is also a factor of degradation of rangelands. It accounts for 2.5% of responses in the study area. Gully erosion is an advanced stage of rill erosion, while the latter is an advanced stage of the sheet erosion. These types of erosion are common in the study area. In most of the places, the gullies are at their initial stage and in other areas; they are at developing stage due to high runoffs down the hill slopes. Erosion give rise to bare ground spots in the grazing fields thus hindering good pasture development. Generally, erosion hazard in the study area has been aggravated, mainly due to overgrazing of rangeland as said by pastoralists. Due to overgrazing, the top soil is easily carried away by runoffs and makes the soil more volatile to the advanced stages of erosion. Participants also iterated that, erosion is most visible and serious during the months of July, August and September characterized by very high rainfalls. This causes the streams and rivers sometimes to overflow, thus not only causing erosion but damaging crops of both pastoralists and farmers and sometimes animals as well.

3.4.2.5 Population pressure

Population pressure accounts for 6.1% of responses as a cause of rangeland degradation. Faro et Deo and Djerem

are one of the divisions that the populations are gradually growing. These are border divisions with growing economies due to trading and agriculture. Population pressure leads to over-exploitation of rangeland resources which is a contributor to rangeland degradation.

3.4.2.6 Limited care and attention paid to rangelands

Pastoralists (15.4%) also consider the very limited attention paid towards rangeland management by stakeholders as one of the reasons that contribute to degradation. Efforts geared towards rangeland management such as bush clearing, destocking, good fire practices, pasture amelioration, etc. are very limited in these communities said the pastoralists. Limited bush clearing and absence of controlled bush fires are one of the most under looked aspects of their rangelands the pastoralists iterated. According to literature, there are very few rangeland experts at present in the country (Blasius, 2009). This makes it difficult for proper community sensitization on rangeland management. Participants from focus group discussion said, the most challenging problem they face during the dry season was that of uncontrolled bush fires, where unknown men especially hunters set the bush ablaze with no defending force to quench the fire.

Sometimes the fire end up consuming huts of pastoralists and cross to farmlands damaging crops. They said communities have to be sensitized on the socio-economic dangers of bush fires. A complete absence of community campaigns to clear bushes that have encroach on rangelands is also a typical problem faced in the study zone. Focus group participants said this strategy could go a long way to solve the problem of rangeland degradation. However pastoralists use their small resources and efforts to eradicate bushes on their rangelands at an individual level, in which most of the time is not effective because of very little or no external support.

3.5. Consequences of rangeland degradation on the local communities

The following are the consequences of rangeland degradation enumerated by the pastoralists in the study area:

3.5.1. Poor livestock productivity and Decreased in the 'cheptel' (Total holdings)

The following Table is an indicator that the average herd holdings of pastoralists have drastically drop in recent years.

Table 4: Average herd sizes of pastoralists in the study area.

Parameters	Frequency	Percentage(%)
1 Herd	64	22.9
2 Herds	103	36.8
3 Herds	47	16.8
4 Herds	34	12.1
5 Herds and above	23	8.2
Total	271	96.8

From Table 7 above, a large majority of pastoralists in the study area own between 1 and 2 herds of cattle (22.9% and 36.8% respectively). An average herd size has 50 animals (Regional delegation MINEPIA, Ngaoundéré). The average herd holdings of pastoralists have drastically reduced in recent years as compared to the past they said. The key contributing factor to this they said was the degradation of their rangelands.

Most of the respondents said, their individual grazing area is not favorable to support more than 5 herds, reason why they rotate averagely between 1 and 2 herds while aiming for an increase. However, rangeland degradation is the main constraint for their average herd size decrease. Due to this decrease, livelihood has become difficult for

the pastoralists in the study area. It makes it difficult for them to support their large families (as most of them are polygamous), educate their children, and construct better houses and other welfare facilities just from their small herd sizes they own. This explains why a majority of them now practice crop cultivation as a complement, as mentioned earlier.

3.5.2. Socio-economic and cultural consequences.

Another negative consequence of rangeland degradation on the local communities is the socio-economic and cultural effects it leaves on the population. The following figure paints a picture of this phenomenon.

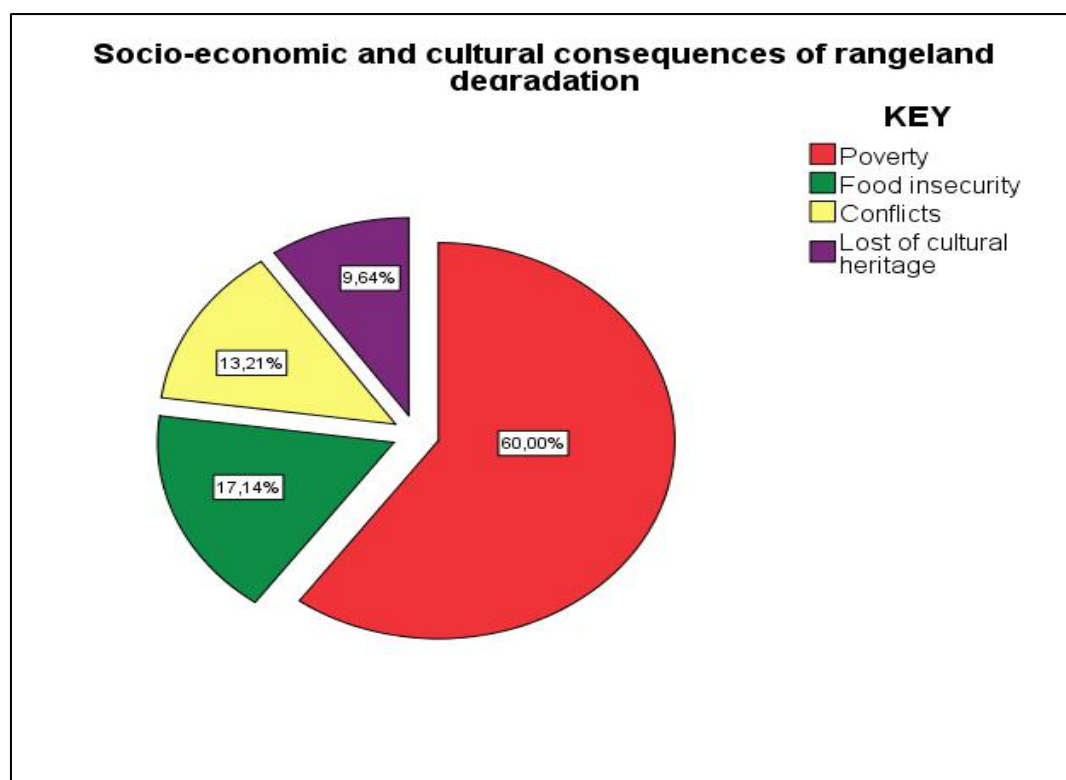


Fig.3: Socio-economic and cultural consequences of rangeland degradation on the local communities.

From Figure 7 above, the socio-economic and cultural consequences of rangeland degradation on the local communities include; poverty, food insecurity, conflicts and loss of cultural identity/heritage accounting for 60.00%, 17.14%, 13.21%, and 9.64% of responses respectively.

Poverty: Over 60.00% of pastoralists said poverty is the main negative consequence of rangeland degradation. This is because when there is reduction in average herd holdings and productivity the income per head automatically drops. Sometimes, disease prevalence provoked by poor rangeland management practices leads to poor morphological presentation of cattle. As a result, the revenue earned from sales has drastically reduced, thus leaving the pastoralists in acute poverty. This is similar to the findings of Blasius, (2009) in relation to problems faced by pastoralists in the Far North Region.

- ✓ **Food insecurity:** Pastoralists said, due to the deteriorating condition of their rangeland, cattle quality and quantity has dropped thus having a negative impact on food security (physical and economic access to sufficient and nutritive food that meet up dietary needs and food preferences). Most of the respondents depend entirely on the natural pasture which is poor in nutritional balance, thus making fattening a difficult task. The low weight cattle when put in the market cannot earn much income for the pastoralists and their families. They keep on rotating about this vicious cycle, as there is no attempt made to improve on the pasture, method of breeding or types of breeds.
- ✓ **Conflicts:** Some of the pastoralists (13.21%) said rangeland degradation leads to conflict between them and other rangeland users. The following cross table paints a picture of rangeland conflicts and their types in the study area.

Table 5: Cross table on rangeland conflicts and their types in the study area

Do you face rangeland conflicts in your present locality?	If yes, what type of conflict?		TOTAL
	Farmer-Grazer conflict	Other land-use conflicts	
	87.50%	10.71%	98.21%
TOTAL	87.50%	10.71%	98.21%

From table 8, a large majority of pastoralists said they face rangeland conflicts in their localities and that the main type was the Farmer-Grazer conflict which is the most common type of conflict in pastoral communities.

According to pastoralists, the main cause of these conflicts is as a result of rangeland degradation as highlighted in the table below:

Table 6: Pastoralists' opinions on the main causes of farmer-grazer conflicts

Parameters	Frequency	Percentage(%)
Rangeland degradation	249	88.9
Limited land	15	5.4
Mismanagement of land	10	3.6
Poor human relations	06	2.1
Total	280	100.0

From Table 9, a large majority of over 88.9% of pastoralists confirmed that the root cause of farmer-grazer conflicts is rangeland degradation. Some of the respondents said keeping more herds entails a very difficult task, in maintaining peaceful relationship between them and their neighboring farmers. A great majority of the respondents still practice free grazing (83.2%) while only 16.8% has adopted the paddocking system (Field statistics). Again, according to field results, a great majority of respondents (91.4%) said the grazing system ownership in the study area is communal which directly implies there is utilization of common pool resources. The animals therefore roam freely travelling long distances and sometimes enter into farmlands, destroying crops of neighboring farmers, who sometimes confiscate the animals and demand for payments from the pastoralists. When an agreement is not reached between these two parties, it leads sometimes to fatal conflicts thus putting their relationship at jeopardy.

✓ Loss of cultural identity/heritage.

According to some pastoralists (9.64%) loss of cultural identity or heritage is a negative consequence of rangeland degradation. Results from the religious and cultural

background in the first section of this chapter shows that a large majority of pastoralists (71.78%) in the study area are Fulani or Fulbé. They claim that cattle rearing is an activity which is highly attached to their cultural identity and/or heritage. This is similar with literature from Encyclopedia of world cultures which reads: “*The Fulani are one of the largest ethnic groups in Africa with cattle rearing as their main livelihood activity*”. As a result, a fall in cattle productivity and herd size holdings will automatically mean a fall in the cultural identity of the Fulbé.

3.5.3. Consequences on Herd mobility

According to Field statistics, a large majority of pastoralists (81.8%) practice herd mobility otherwise known as transhumance. During this period, they move with their cattle and belongings from the uplands or hills and descent down to the valleys.

The cross table below gives a detail of this and highlights the various reasons that push pastoralists in the study area to practice herd mobility or transhumance.

Table 7: Herd mobility in the study area

Do you practice herd mobility?	If yes, what pushed you?		TOTAL
	In search for pasture and water	Other reasons (please specify)	
	81.78%	0.00%	81.78%
TOTAL	81.78%	0.00%	81.78%

From Table 10, all 81.78% of pastoralists without exception who practice transhumance said their main reason was in search for pasture and water. This is because they do not have sufficient pasture and water to cover the dry periods which is usually harsh and long. The transhumance period is usually 4 months as majority of the pastoralists (75.70%) declared (Field results).

They travel with their cattle from the beginning of January to only return back at the end of April or beginning of May. Again the main cause of this is due to the degradation of their rangelands. It is usually a cumbersome trip that leaves at times, negative impacts on both the pastoralists and their cattle as they said. It is sometimes counterproductive since they find themselves in a win-lose situation. Related to this, is the usual farmer/grazer conflicts they come across due to settlement of farmers along transhumance corridors. Sometimes these corridors are not well equipped with drinking points and other logistics to cater for the pastoralists and their animals as the participants of focus group iterated. Some of the hosting structures in the study area during transhumance are Tigné (SODEPA Faro ranch), Mayo Baleo (*sabbal Mbana, Gandaba* etc.), Galim-Tigné (*Sabbal Babo*), Kontcha, etc. (2019 Annual Report MINEPIA, Faro et Deo) The long distances covered by cattle during this period affect their body weights drastically. Some end up dying on the way (especially the calves), while others finally reach with much fatigue and takes time to regain momentum, thus leaving the pastoralists with much losses (*Divisional Delegate, MINEPIA, Faro et Deo*). This is usually the most difficult period of the year for the pastoralists as the participants said. They also have to sacrifice and leave their families behind and sometimes come back only after the transhumance period thus depriving them ¼ year from their homes. All these are driven by the degradation of their rangelands.

3.5.4. Rural exodus and high crime waves.

Rangeland degradation has caused the massive movement of people (herdsmen most especially) from the present

study site (being a rural area) to urban centers and nearby cities like Ngaoundéré, Yaounde, Douala, etc. iterated the pastoralists. When the land is no longer fit to support livestock production (degradation), there is automatically a reduction in the '*cheptel*' and in the average herd holdings of pastoralists. When the average herd holdings of pastoralists reduce or completely gets finished, he/she cannot longer sit in the same spot. This automatically pushes the pastoralist(s) to search for alternative sources of revenue which can support their large families (Given that majority of them are polygamous). When this occurs, it creates a shift in labour from agriculture and livestock production (which is the backbone of the Cameroon economy) to other non-professional domains like motor-biking, hawking, etc.

Apart from rural exodus some pastoralists after losing their herds due to rangeland degradation decides to join men of the underworld in promoting crime waves. This is a reality especially in the study area where there has been a lot of insecurity during recent years with the advents of "*JAR'GINA*" / "*Couper-des-routes*". The root cause of this is idleness resulting from either loss of herds due to rangeland degradation or lack of industries to provide jobs for the youths in the localities.

3.5.5. Biodiversity lost

Biodiversity loss is a reality in the study area. Some animal and plant species have been extinct due to over-exploitation of rangeland resources the pastoralists iterated. This accompanied with climate change and global warming the pastoralists in the study area are situated at a very difficult crossroad to regenerate and/or rehabilitate their rangeland condition. As mentioned above, it has become very difficult to control activities of hunters and poachers especially in the Faro game reserve which happens to be a prestigious reserve within the region and country as a whole. There is risk of losing some species of animals and plants alike in the reserve (Source: *Poste Forestier de Libong-Marché*).

In a similar light, traditional/indigenous medicine which is rapidly gaining grounds nowadays uses rangeland resources (Roots of plants, xylem and phloem of trees, leaves etc.) as principal recipients for their concoctions. This has led to the disappearance of certain vital plant species within savanna areas. The pastoralists iterated that they have to travel sometimes very long distances just to fetch medicinal plants which used to be abundant in their surroundings a decade ago. This shows the fast disappearance of rangeland resources that may put the future generation into jeopardy.

3.6. Rangeland management in the study area

3.6.1. Indigenous rangeland management practices and adaptation strategies used by pastoralists in the study area.

Despite the degradation of their rangelands, pastoralists in the study area have devised several means to secure the rangelands from degradation. However, most of these measures are to reduce the rate of degradation as it cannot be completely stopped.

a. Precautionary bush fire.

One of the ways pastoralists of this area reduce rangeland degradation is by practicing controlled bush burning through the use of bush fires; usually during the dry season. Here, one part of the grazing field is set on fire while cattle graze on the other part and when the former starts to produce pasture, the latter is then also set on fire. Bush burning helps to eradicate old and dry pasture, trees, shrubs and other unfriendly species of plants. However in some parts of the study area (especially in Tigné and Galim-Tigné subdivisions), bush burning have been very cumbersome for the pastoralists in recent years. They said, too much trees and shrubs encroachment, has made burning very difficult as fire cannot easily consume them.

Table 11 gives statistics of the number of pastoralists that practice bush burning and their perceptions on bush fires.

Table 8: The use of fires in rangeland management and the perceptions of pastoralists

Do you use fire in the management of rangelands in your area?		Do you believe the practice of bush burning is good for rangeland management?		TOTAL
		YES	NO	
YES		259	4	263
NO		3	14	17
TOTAL		262	18	

From the frequency table above, over 92.50% (259 counts) of pastoralists, use fire in the management of their rangelands and believe bush fire is good for rangeland management. 1.42% (4 counts) of pastoralists also practices the use of bush fire. However, they believe it is not good for rangeland management. The former group gave reasons that, bush fire is good for rangeland management because it helps to clear off bushes and unwanted plants, thus giving way for new and soft shoots of pasture which is suitable for their cattle. This is similar with the writings of Richard Forsman in his concept notes for rangeland management who said “Fire is an important regulator of range vegetation, whether set by humans or resulting from natural igniters (lightning)”. Fires tend to reduce the abundance of woody plants and promote

herbaceous plants including grasses, forbs, and grass-like plants (ibid.). Focus group participants also said bush fires help to clean their environment from bushes, wild animals and other reptiles like snakes.

However, the latter group of pastoralists said though they use bush fire, they believe it is not good for rangeland management. Bush fire is environmentally unfriendly, they iterated. They based their judgments on environmental and biodiversity conservation. Bush fire destroys micro-organisms in the soil and causes global warming, leading to climate change they continued. Therefore according to their opinion, the sustainability of environmental protection needs to be guaranteed by limiting the use of bush fires. This is closed to the results of Herrera et al., (2008) regarding rangelands and bush fires.

b. Mechanical and chemical fight against bush encroachment.

✓ **Mechanical fight (Bush clearing).**

Another conservation measure pastoralists use to reduce rangeland degradation is clearing of bushes (Mechanical fight) that have encroached on their rangelands.

They simply reduce bushes without necessarily burning. According to members of focus group discussion, the pastoralists at an individual level reduce bushes, shrubs, trees and other unfriendly species of pasture from their grazing area. They do this by cutting, pulling and sometimes digging. This is done with the help of local materials such as; cutlasses, hoes and diggers. However, this measure is not very effective because of the high cost it demands. According to the divisional delegate for Livestock, Fisheries and Animal Industries, monthly campaigns are usually organized amongst grazers of the same communities to clear off bushes that have encroached on their rangelands. This was done every first Saturday of every month. However, this initiative is no longer effective because the grazers themselves boycotted the programme. He also iterated that there is a lot of disunity amongst pastoralists reason why such good initiatives cannot be effectively realize.

✓ **Chemical fight (Use of selective herbicides and aboricides).**

Pastoralists have recently resorted to the use of selective herbicides and aboricides in the clearing off of bushes that have encroach their rangelands. This method did not exist in the past they said. According to them the mechanical fight through bush clearing is very costly and cumbersome (tedious). There is a lot of time and energy sacrificed. Despite its very high demands, very little space is covered in a very long period of time they iterated.

However with the advent of technology of the new age, there are a wide range of selective herbicides and aboricides that are used in the fight against unwanted species of grass and trees/shrubs respectively. These chemical products are used to spray the rangelands which have been colonized by bushes. Before the spraying takes place, animals are diverted to other paddocks for their grazing and can only come back at the site in question after a certain fixed period. According to field statistics over 56.50%

of pastoralists in the study area have already tested this experience in one way or the other. They however deplored certain inconveniences in the use of chemical products on rangeland. They include:

- Limited knowledge on the use of chemical products since a majority of the pastoralists (72.86%) are non-lettered.
- Majority of the pastoralists do not use protective covers/wears e.g. gloves, blouse, etc. and do not even take into consideration appropriate periods of spraying. As a result, they are exposed to health hazards which can be cancerous in the long-run.
- Furthermore, pastoralists during spraying care less about the environmental impacts in the future. They sometimes wash the remains in water bodies which end up affecting biodiversity negatively. The waste/remains on land surfaces are most of the time non-biodegradable which ends up polluting the environment.
- Due to limited knowledge on utilization, there are circumstances of over-dosage which kills biodiversity in the sub-soil which are indispensable for man and his environment.

c. Seasonal herd mobility or transhumance

Despite the negative effects of herd mobility on both the pastoralists and their herds, pastoralists still resort to this short term management strategy as a means of securing their rangelands. As seen earlier, over 81.78% of pastoralists practices herd mobility. Mobility allows the pastoralists to respond quickly to fluctuations in resource availability thereby maintaining their herds and other assets as well as their productivity. It allows tracking changes in the dramatic fluctuations in feed supply, avoiding areas where forage is insufficient and mopping up surpluses where they are abundant (Behnke, 1994). According to them, seasonal herd mobility assists in various ways. Foremost is the access to fresh/high quality pasture and water sources. Furthermore it helps in avoiding overgrazing of their grazing fields, escape from diseases, conflicts and drought conditions.

d. Paddock system

According to field results, 83.2% of pastoralists exploit the free system of grazing

while 16.8% has adopted the rotational grazing or paddocking system. The latter group explained the factors favoring their adoption of this system of grazing;

- ❖ It reducing overgrazing of pasture fields; Rotational grazing just as the name indicates, concentrates animals in one paddock for a period of time. After this fixed duration, the animals are later shifted to another paddock.
- ❖ It is an organized form of grazing which reassures the availability of pasture at all seasons they said.
- ❖ It is a system which limits the spread of diseases amongst heads.
- ❖ It also controls the colonization of bushes within pastures.

The pastoralists however deplored the very high cost of creating paddocks despite its usefulness in animal husbandry. Working materials such as bap wires, nails, hammer, machetes, diggers, sticks/poles, etc. are indispensable for the process. The individual pastoralists with his/her little income cannot afford these basics. Through this system, it becomes very cumbersome for an individual pastoralist to secure 1Ha piece of land with paddocks.

e. Destocking of herds.

This is one of the most serious problems faced by pastoralists in the study area. Most of the favorable sites for grazing have been

inundated with herds from either neighboring regions e.g. North west, East, North and Far North or countries e.g. Nigeria, RCA, and Congo. When too much herds become concentrated in one spot, it creates the phenomenon of overgrazing.

High plateau zones in the study area like 'Sabbal Mbabol', 'Gandaba', and 'sabbal Mbana' 'Sabbal Karedje' etc. are examples of good pasture zones which have recently been occupied by a lot of external herds. As a result, it leads to the scenario of 'Tragedy of the commons' given that most of the pasture fields have been overgrazed. Pastoralists in recent years have reduced (Destocking) the average herd size holdings within these and other zones to secure a sustainable animal husbandry in the study zone.

f. Adoption of improved pastures

Pastoralists in the study area do not only rely on natural pasture for the feeding of their animals. They have adopted especially most recently the planting of improved/hybrid pastures such as *Bracharia* spp., *Pennisetum purpurium*, *Trypsacum laxum* and *Stylosanthes* spp. These hybrids help to supplement animals especially during harsh periods like the dry season. Again pastoralists also complaint that the adoption of improved pasture is very costly especially at the individual household level. As a result community farms should be created by the councils or Government for the question of sustainability.



A



B

Photo 7: *Bracharia* pasture farms in Libong and Tignère (both in Tignère sub-division) respectively.

g. Pastoral hydraulics.

Water bodies e.g. rivers, lakes, springs, seas, oceans etc. are one of the most important rangeland resource. Therefore its degradation equals to rangeland degradation.

Apart from good quality pastures, water is also an indispensable element in animal production. All 100.00% of pastoralists in the study area utilize the natural drinking points. They explained that an individual pastoralist with just few herds cannot afford to construct forage for animal drinking. As such they all resort to natural drinking sources. Sometimes the entrance to drinking spots (*Regoldés*) are inaccessible either because of mud created from animals' stampits or from other forms of land degradation. When these occur, pastoralists organize team works/community works and rehabilitate locally or create another '*regoldé*'.

4.4.4.2. Existing institution that tackles rangeland degradation in the study area

The role played by the Government and Non-governmental organizations cannot be undermined in this study. Rangeland management is a key investment area amongst all forms of land management programs. It is not only cumbersome but very expensive and demanding. Most of the times, it demands projects that can only be sponsored by a legal institution such as Governmental organizations/projects/programs or NGOs.

It is therefore important to assess and evaluate the role of these institutions in rangeland management.

➤ Role played by Government owned institution(s) dealing in rangeland management in the study area.

According to Field statistics, 11.4% admitted their awareness of governmental organization/project/program dealing in rangeland degradation against 88.6% who said they aren't aware of any such support structures in their communities. These results are displayed in the following figure.

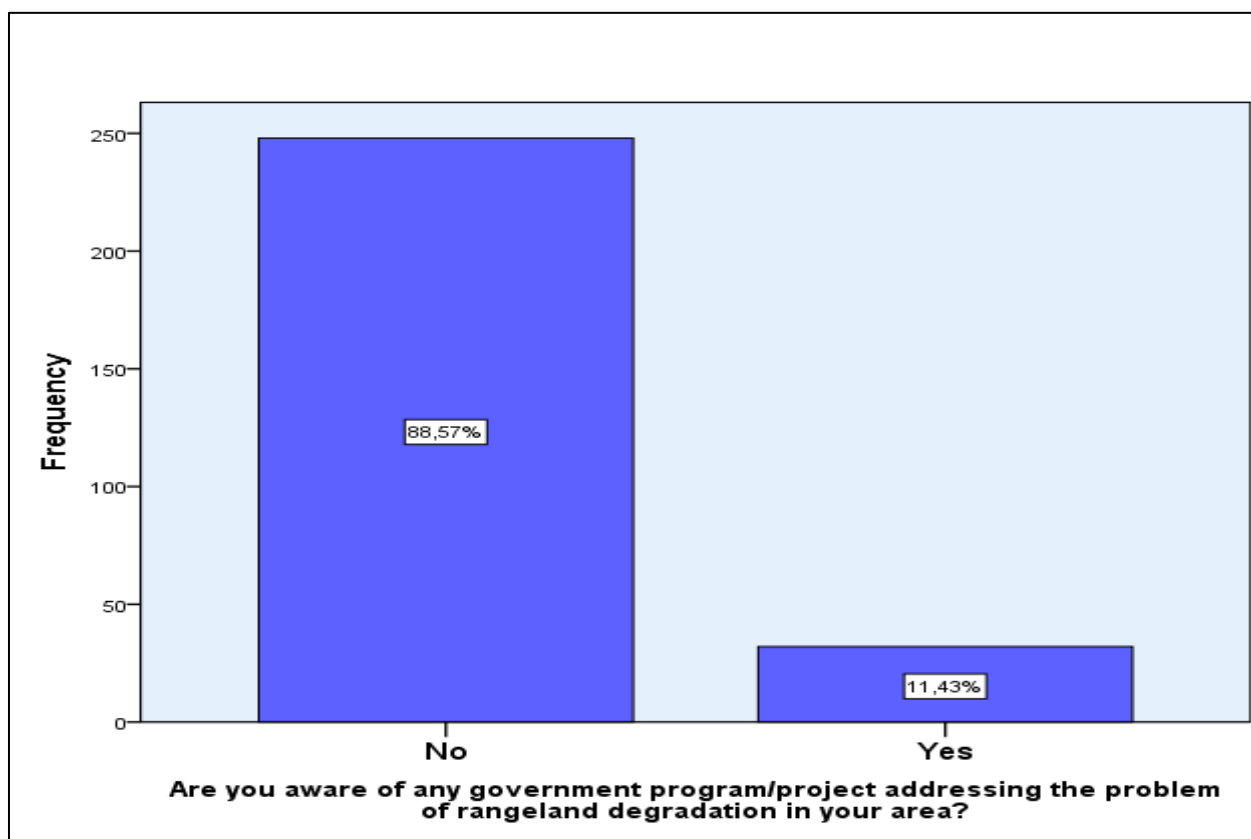


Fig.4: Pastoralists' awareness of Government support institution(s) in rangeland management in the study area.

From the above figure, a large majority of pastoralists (88.57%) declared that they aren't aware of any

government structure dealing in rangeland management in their locality.

Pastoralists were further asked if they think the measures taken by the government to address the problem of

rangeland degradation were effective. Here are their responses presented in the following cross-table.

Table 9: Effectiveness of Government institution(s) in addressing rangeland degradation in the study area.

Do you think the measures taken by the Government to improve rangeland condition are effective?		If yes, which project/program and how successful was it in addressing rangeland degradation?		TOTAL
		PNDP	PRODEL	
YES		7.86%	3.57%	11.43%
TOTAL		7.86%	3.57%	11.43%

Statistics from Table 13 shows that 7.86% of pastoralists that believed that measures taken by the government to improve rangeland condition are effective recognized PNDP as the program that has fully addressed the problem of rangeland degradation in the study area. On the other hand, 3.57% that confirmed government support admitted that PRODEL is the project presently addressing the question of rangeland degradation in their community.

PNDP (*Programme National pour le Développement Participative*) is a national program that addresses local participative and integrated development at the grassroots level. This program has been in the field (including the study area) for closed to a decade now. It covers both the domains of agriculture and livestock development alike. It is a participative development program that touches people of the grassroots. According to the pastoralists, this program has realized the following works in their communities;

- ✓ **Domain of pasture amelioration:** The creation of several community pasture fields with hybrid pasture like *Bracharia rugigensis*, *Stylosanthes spp.*, *Crotalaria spp.*, etc. These pasture plots serves the communities especially during the dry season. The creation of these farms are purely

government sponsored with funds from international organizations and bodies.

- ✓ **Domain of pastoral hydraulics:** Similarly, the area of pastoral hydraulics has not been left out by this program. Forages for both human and animal drinking are spotted in certain localities created by PNDP. These serve animals mostly during the dry season.
- **Role played by Non-governmental institution(s) dealing in rangeland management in the study area.**

Similar to the role played by government institutions, Non-governmental institutions (projects, programs, organizations, etc.) also contribute in rangeland management in the study area. However, their action is very limited especially in areas of amelioration of pasture, drinking points, etc. They mostly intervene during conflicts (e.g. Farmer-Grazer conflicts) and other community projects like the supply of portable water to communities, building of schools and community halls etc. The following cross table presents the responses of pastoralists on the existence of Non-governmental institution(s) in the study area.

Table 10: Existing Non-governmental institution involved in rangeland management

Are you aware of any Non-governmental institution(s) involved in rangeland improvement in your locality?		If yes, what is the name of the project, program or organization?		TOTAL
		UDEFAD	MBOSCUDA	
YES		5.15%	3.00%	8.15%
TOTAL		5.15%	3.00%	8.15%

Table 14 above depicts that, the only two Non-governmental institutions involved in rangeland improvement especially pasture are ASEFAD and MBOSCUDA accounting for respectively 5.15% and 3.00% of those who confirmed their awareness of NGOs existence in the study area. UDEFAD (*Union Des Elèveurs du Faro et Deo*) is an organization that brings together all pastoralists within the division. It mostly defends the rights of pastoralists especially in conflicts scenario with other rangeland users and also helps in regulating cattle market prices. MBOSCUDA (*Mbororo Social and Cultural Development Association*) works in similar light with UDEFAD but however lay emphasis on

the social and cultural development of the mbororo pastoralists.

3.7. Pastoralists perceptions on the most possible and workable solution(s) to the problem of rangeland degradation.

It is important to know what pastoralists perceive to be the most workable solutions for rangeland degradation, so as to contribute to a sustainable rangeland management in the region in particular and the country as a whole. The following figure highlights sustainable solutions proposed by pastoralists in the management of their rangelands.

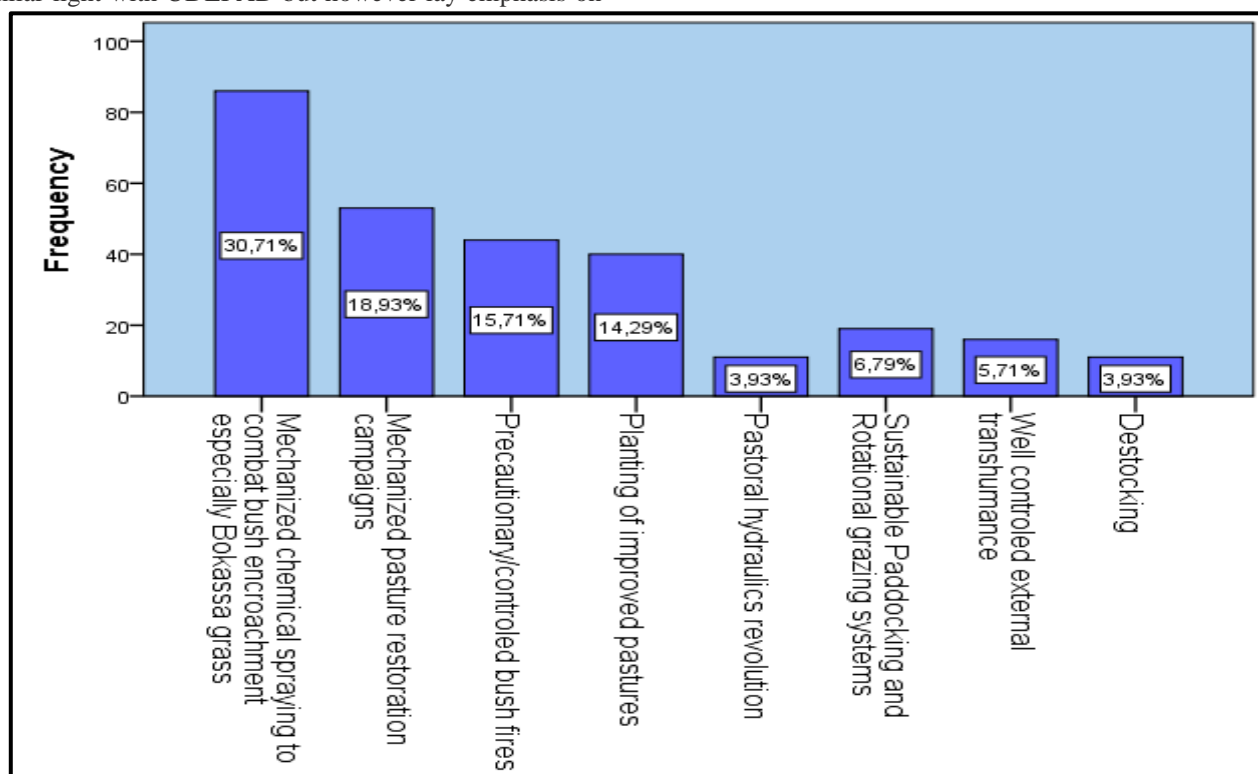


Fig.5: Most important workable solutions for rangeland degradation proposed by pastoralists in the study area.

I. Mechanized chemical spraying to combat bush encroachment especially Bokassa grass.

According to a majority of the pastoralists (30.71%) the most important workable solution for rangeland degradation is the chemical spraying of bushes through a mechanized system. Statistics from previous results show that the principal cause of rangeland degradation in the study area is the encroachment of bushes especially the bokassa grass specie. This group of pastoralists explained that chemical fight is the only sustainable way against bush encroachment since bush clearing is very costly and time consuming.

II. Mechanized pasture restoration campaigns.

Furthermore, according to another group of pastoralists (18.93%), pasture restoration campaigns are the most important workable solution(s) for rangeland degradation. They however pointed out that, these campaigns at the individual level are very cumbersome, time-consuming and costly. As a result, it needs to be highly mechanized through the use of machines. According to focus group participants, some of their rich counterparts own engine saws that are used in pasture restoration in some localities.

III. Precautionary/controlled bush burning.

As seen previously, a great majority of pastoralists use bush fires in the management of their rangelands. They believe precautionary/controlled bush burning can be a practical solution for rangeland degradation. Again, according to them, the ideal period for burning should range from ending October to early January depending on the zone, specie of grass, and the state of pasture. Furthermore, selected members from communities based on experience and wisdom should be reserved for this activity and it should be well organized. The hour of the day for burning should also be taken into consideration.

According to focus group participants, burning clears off unwanted grass, shrubs and sometimes trees none desirable/palatable to bovine and permits or gives space for palatable fresh shoots to germinate and colonize the pasture area.

IV. Adoption of improved pastures.

According to 14.29% of pastoralists, rangeland degradation can be reduced by planting improved grass species like bracharia, Guatemala, stylosanthes etc. to complement the already existing natural pasture and to replace or colonize areas intruded by unpalatable and unwanted species like bokassa, mimosa, etc. Again, the adoption of improved pastures at the individual level and their implementations could

be very costly said the pastoralists. The Government and NGOs should therefore step in more efforts to promote this sustainable way of managing rangelands.

V. Pastoral hydraulic revolution.

The word revolution is used here by pastoralists to signify a massive/wide spread construction/investment/rehabilitation of pastoral hydraulic resources within the study area. The rehabilitation of cattle drinking spots have long been forgotten by stakeholders involved in rangeland management they said. Given that this is very costly at the individual level, the conditions of these spots have become very deplorable in recent years. Pastoralists (3.93%) suggested that there should be construction of forages, boreholes, wells, and rehabilitation of natural drinking spots for their animals. The artificial drinking spots serve especially during the dry season while the natural ones are used all round the year depending on the state and water table.

VI. Sustainable paddocking and rotational grazing systems.

One of the principal causes of overgrazing is the continuous grazing on the same piece of land by animals especially large ruminants like cattle said the pastoralists. When overgrazing occurs, it creates a bare soil which provokes soil erosion. Paddocking is a sustainable system where the grazing of livestock is continuously kept under rotation within sub units (paddocks) following the availability of pasture. Transhumance is a yard stick that also helps pastoralists most especially during the dry season permitting them to do seasonal mobility with their herds and only come back to their respective homes when conditions have become favorable. Again, the creation of paddocks is a very demanding activity in terms of finance, materials and time said the pastoralists.

VII. Well controlled external transhumance.

As said earlier, high stocking rates has an adverse impact on rangeland health. It leads to overgrazing which is one of the serious causes of rangeland degradation. 5.71% of pastoralists advised that a meaningful rangeland management system should integrate a well-controlled external transhumance in which the number of animals from neighboring countries such as Chad, Central African Republic, and Nigeria etc. should be reduced. Again, as seen earlier, the history and evolution of the bokassa grass shows that it was transported by animals from the Central African Republic which came in for transhumance and/or driven by conflicts. In a similar light, animals

coming from these neighboring countries needs to be vaccinated first with all the 4 key vaccines (SYMPTOVAX, PASTOVAX, NODULOVAX, PERIVAX and sometimes APHTOVAX) before entry are permitted. This is to prevent our animals from within from contamination.

VIII. Destocking of herds.

One of the most serious problems expressed by pastoralists in the study area is the insufficient grazing space caused by overstocking of herds. According to 3.93% of pastoralists, a practical workable solution to this problem is the draining out (destocking) of herds and sending them to other spacious grazing zones. This reduces overgrazing, disease infestation and even bush encroachment. Some focus group members expressed that there are pastoralists owning more than 5 herds on a small surface area and when the animals overgraze the pasture, they are forced to intrude to other neighboring pastoralists who also have their own herds. When all this occurs, it leads the phenomenon of the tragedy of the commons.

IX. Controlled harvesting of veld products.

This was not a response *per se* in the individual household questionnaire but was proposed by focus group participants as a practical workable solution for rangeland degradation. As seen in earlier results, there is over-exploitation of veld resources on rangelands in the study area. Depletion of local resources such as good quality thatch grasses, some important medicinal plants, fuel wood, other construction materials (e.g. raffia bamboos, sticks, etc.) are clear signs in the study area. The pastoralists also deplored that the population pressure is gradually increasing due to conflicts and social unrest in neighboring regions like the North West/South West, North/Far North and neighboring countries like Nigeria, Central African Republic, and Chad. High population pressure implies higher exploitation of rangeland resources which in turns leads to rangeland degradation if these resources are not exploited sustainably.

X. Good rangeland governance.

According to a majority of Focus group members (Approximately 70%) rangeland management fails most of the time because of very poor institutions and poor governance from both Government and Non-governmental bodies. There are no concrete or practical policies on the ground that deals with rangeland management in the country. Even if it exists, it is not being implemented on the field said the

pastoralists. Furthermore, as seen earlier in the literature, there is not even a single University in the country that offers a diploma in rangeland management. This proves very sufficiently that there is very limited research attached to rangelands of the country. In summary, good rangeland governance give rise to good policies necessary for the sustainability of rangeland management.

IV. CONCLUSION

Rangeland degradation has increasingly become a threat to the pastoral production systems and has resulted in substantial decline in rangeland condition, water potential, soil status, and animal performance, livestock holding at the household level which in turn leads to food insecurity, poverty to the extent of food aid and the need for alternative livelihood income and diversification. Despite the negative consequence of rangeland degradation, the achievement of sustainable rangeland ecosystems remains a challenge for Cameroon in general and the Adamawa highland plateau in particular; rangeland degradation has not been arrested and the ecosystem services provided by the rangelands are not valued.

The degradation of rangelands is progressing at an alarming rate which gives the impression of difficulty to restore it in the future. Therefore, research and development should focus on sustainable rangeland industries and to develop strategies that relieve disturbance of rangelands and permit the restoration of stressed and dysfunctional rangelands.

The study was conducted in the Adamawa highland plateau, with the purpose of assessing the perceptions of pastoralists regarding rangeland degradation. This was achieved by assessing more specifically; pastoralists awareness of the degrading condition of their rangelands, current status/condition of the rangelands, the major root causes and drivers of rangeland degradation, consequences of rangeland degradation on the local communities, indigenous/scientific rangeland management practices and a methodological framework to guide stakeholders for continuous sustainability. The methods of study included the use of structured and semi-structured survey questionnaires from 240 sampled pastoralists, focus group discussions and field observation. The study covered all the 4 sub-divisions of Faro & Deo within the highland. These units were selected based on the intensity of rangeland degradation (high, medium and less).

Based on the findings of the study, the highest represented age group in pastoral activities falls within 20 – 59 years. Majority of the respondents were married with average household sizes varying between 1 and 15 persons. A large

majority of these pastoralists (71.8%) belongs to the Fulani ethnic group and a large number of them (72.86%) were unlettered having no formal level of education. Their main livelihood activity proved to be both cattle rearing and crop cultivation as over 86.43% were agro-pastoralists with a certain degree of sedentarization. The study demonstrates very sufficiently that, pastoralists are aware and well acquainted with the degrading state of their rangelands. A great majority of over 93.6% of respondents said their rangeland condition is poor and not conducive for cattle rearing and that there is drastic decline in the quality of pastoral resources found on these rangelands. Through the indigenous ecological knowledge of pastoralists, they could tell how these changes have evolved over the past 10 years. Therefore the condition of rangeland in the study area proved to be poor. The main drivers of degradation proved to be both physical and human with the following root causes: overgrazing, bush encroachment, uncontrolled bush fires, soil erosion, population pressure and limited care/attention paid to rangelands. Furthermore, rangeland degradation left several negative consequences on the local population including; poor livestock productivity and decrease in 'cheptel' (total holdings), socio-economic and cultural impacts (including poverty, food insecurity, conflicts and loss of cultural heritage), rural exodus and high crime waves, AND Biodiversity loss.

Nevertheless, pastoralists in the study area through their indigenous ecological knowledge devised measures and adaptation strategies to manage and conserve their rangelands. Some of these measures include; Mechanical and chemical fight against bush encroachment (Bush clearing and use of selective herbicide respectively), seasonal herd mobility/transhumance, use of paddocking systems, destocking of herds, adoption of improved pastures, and improvement on pastoral hydraulics.

Government and NGOs' supports to rangeland management, proved to be very limited in the study area. However the main government and NGO supporting platforms are (PRODEL, PNDP), and (UDEPAD, MBOSCUA) respectively. Notwithstanding, the most workable solution(s) to rangeland degradation proposed by pastoralists include; Mechanized chemical spraying to combat bush encroachment especially bokassa grass, mechanized pasture restoration campaigns, precautionary/controlled bush burning, adoption of improved pasture, pastoral hydraulic revolution, sustainable paddocking/rotational grazing systems, sustainable external transhumance, destocking of herds, controlled harvesting of veld products and good rangeland governance. Finally, a participatory approach in which relevant indigenous knowledge of pastoralists and

conventional scientific knowledge may be integrated to reduce community vulnerability to rangeland degradation was developed through a methodological framework developed with stakeholders for continued sustainability.

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